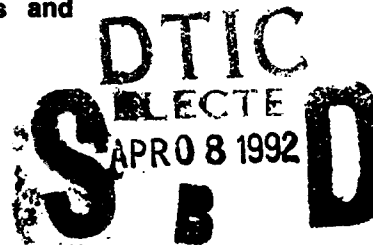




**THE EFFECTS OF STUDENT-INSTRUCTOR INTERACTION AND
PAIRED/INDIVIDUAL STUDY ON ACHIEVEMENT
IN COMPUTER-BASED TRAINING**

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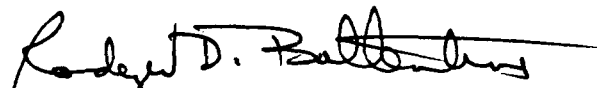
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PREFACE

This report describes the results of a field experiment conducted to explore the effects of two variables on achievement in computer-based training. The two variables were the presence or absence of interaction between student and instructor, and paired versus individual study.

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SUMMARY

Research suggests that small group study and interactions between student and teacher can improve performance in computer-based training (CBT). However, there is no available research on the interaction between these two variables. Therefore, a 2 x 2 factorial design experiment was conducted. The goals were to examine the effects on achievement of student-instructor interactions, paired/individual study, and main effect interactions. Two hypotheses were tested. The first hypothesis was that paired learning would have a positive effect on achievement. The second was that interactions between student and instructor would have a positive effect on achievement. The experimental results support the first hypothesis. They provide only moderate support for the second hypothesis. Perhaps a team partner provides the feedback and support usually provided by the instructor in a traditional classroom setting.

Individual study may not be the best arrangement for CBT. Higher achievement is found when students work CBT in pairs. The approach to CBT development should include social factors during planning and implementation. More research is needed on the social aspects of learning and the role of the instructor in CBT.

THE EFFECTS OF STUDENT-INSTRUCTOR INTERACTION
AND PAIRED/INDIVIDUAL STUDY ON ACHIEVEMENT
IN COMPUTER-BASED TRAINING (CBT)

I. INTRODUCTION

The effects of environmental factors on achievement in computer-based training (CBT) have not been extensively studied. However, McCombs et al. (1984) did find that two such factors were critical to the success of CBT courses. They were: (a) adequate opportunities for student-instructor interactions, and (b) the addition of group activities within individualized training.

Frequent but short interactions between the student and instructor is consistently reported as a positive instructor behavior for traditional instruction (TI). An increase in student-instructor interactions usually produces an increase in achievement (Brophy, 1986; Brophy & Good, 1986; Rosenshine, 1983). Stephenson (1991) examined the effect of such interactions in CBT. He found interaction between student and instructor had a positive effect on achievement. This effect held even when the interactions were unrelated to the CBT content.

CBT is typically conducted in a one student-one terminal setting. For that reason the second McCombs factor, group activities, is seldom found. However, group activities in CBT can occur in other ways. For example, students can work CBT in pairs. There are two bases for using such group activity in CBT.

First, there is a body of TI literature comparing students working in groups to students working individually. This work has focused on the effect of cooperation versus competition. The consensus is that students working in small groups perform better than students working alone. This is especially true in a cooperative setting (Johnson et al., 1985; Warring et al., 1985; Yager et al., 1985). The best group size is either two or three (Cox & Berger, 1985; Trowbridge & Durnin, 1984; Webb, 1987). Studies have also found that paired students should be of the same sex and have similar abilities (Dalton, 1990; Dossett & Hulvershorn, 1983; Hooper et al., 1989; Johnson et al., 1985).

Recent CBT research provides the second basis for arranging CBT students in groups. Achievement of students working CBT in groups of two or three equals or surpasses achievement of students working CBT alone (Carrier & Sales, 1987; Cox & Berger, 1985; Dalton, 1990; Dalton et al., 1989; Dossett & Hulvershorn, 1983; Hmelo, 1989; Johnson et al., 1986; Justen et al., 1990; Shull, 1990; Trowbridge & Durnin, 1984; Webb, 1987). "No study

has reported significantly greater learning when students work alone (Webb, 1987, p. 195)."

Both student-instructor interaction and paired learning can increase achievement in CBT. However, there is no available research on the interaction between these two variables. Therefore, a 2 x 2 factorial design experiment was conducted. The goal was to explore the effects on achievement of student-instructor interaction, paired/individual learning, and main effect interactions. Two hypotheses were tested. First, student-instructor interaction would have a positive effect on achievement. Second, paired learning would have a positive effect on achievement.

II. METHOD

Subjects (Ss)

Subjects were 84 business statistics students. For a class project they used a computer spreadsheet to calculate statistics. All Ss completed a pre-survey to assess their personal computer (PC) and spreadsheet experience.

Experimental Materials

The CBT software consisted of a spreadsheet tutorial which was part of a larger commercial software package. The software package had been designed for an integrated spreadsheet-word processing-database program. The tutorial was basically linear and learner-controlled. Ss could repeat a lesson if desired.

For this study, the larger tutorial was altered to include only the introduction plus that part of the package devoted to using the spreadsheet. The introduction portion (Part A) contained four lessons, and the spreadsheet portion (Part B) contained eight. The tutorials were run on Tandy 1000SX PCs.

An exercise to test mastery of the spreadsheet commands was added to the software. Since the subjects were business statistics students, the exercise used statistical calculations as the vehicle for testing spreadsheet mastery. The experimental material, then, consisted of a CBT spreadsheet tutorial with a statistics-based exercise. Ss worked the exercise on the computer.

Procedure

Ss were randomly assigned by spreadsheet/PC experience to one of four groups. Group I (n=20) worked in pairs and received instructor-initiated interactions. Group II (n=25) also worked in pairs but did not interact with the instructor. Group III (n=20) worked individually with student-instructor interactions. Group IV (n=19) worked individually without instructor interaction. Ss were assigned to teams based on grade point average, college major, and sex. Teams were not forced into either a cooperative or a competitive mode. The partners could interact with each other as desired. All Ss worked the statistics exercise individually.

All groups worked the tutorial in three sessions. In session one, all groups started on lesson 1A and worked for 70 minutes. In the second session, all groups started on lesson B1 and worked for 70 minutes. In the third session, all groups started on lesson B3 and worked for 40 minutes. This gave everyone a single exposure to lessons A1 through A4 and repeated exposure to lessons B1 through possibly B8, the spreadsheet. Since Ss worked at their own speed, total individual subject time on task varied.

After 40 minutes on day 3, all Ss were given 30 minutes to complete the statistics exercise. Ss worked the exercise individually.

At the beginning of day 1 the instructor interacted with all teams/individuals to insure that they were properly logged into the tutorial. Later, the instructor responded to all student-initiated interactions with one or more of three responses. These were: (1) "Try pushing the [ESCAPE] key;" (2) "Try pushing the [SPACE] bar;" or (3) "Re-boot the system and start over." The suggestions were given in sequence. If "Try pushing the [ESCAPE] key," did not correct the problem, then the S was told to "Try pushing the [SPACE] bar." For the groups not receiving student-instructor interactions, these suggestions were the only instructor interactions experienced after the startup on day 1.

Two groups of Ss also received instructor-initiated interactions. In the first session, the instructor initiated four interactions with each team/subject. In sessions two and three the instructor initiated three and one interactions respectively. These interactions were related to location of keys on the Tandy keyboard. For example, shortly before the Back Slash (\) key was needed in the tutorial the instructor would tell the students where that key was located. Key location was explained and diagrammed in instructions given to all. For most Ss, however, key location on the Tandy keyboard was a minor problem. This was due to previous exposure to an IBM keyboard. Instructor-initiated interactions lasted 5-10 seconds.

The instructor provided only information which was already available in the instructional materials. The instructor refrained from commenting, providing feedback, or praising performance.

Dependent Measures

Two dependent measures were recorded. First, performance on the statistics exercise was scored. Second, Ss recorded the spreadsheet commands they used to complete the exercise. Most spreadsheet procedures can be performed in more than one way. A cell entry, for example, can be changed with an EDIT command or by re-typing the entry. This second measure was recorded to assess how many different spreadsheet commands were actually used during the exercise.

III. RESULTS

Tables 1 and 2 show means and standard deviations for Spreadsheet Performance and Use of Spreadsheet Commands. Tables 3 and 4 show the analysis of variance.

Table 1

SPREADSHEET PERFORMANCE Means and Standard Deviations

| <u>SETTING</u> | | <u>INTERACTION</u> | |
|----------------|-----------------|-----------------------|-----------------------|
| | | Yes | No |
| Paired | Low Experience | 44.50/18.17 (n=10) | 42.86/14.10 (n=14) |
| | High Experience | 77.00/12.52 (n=10) | 71.36/16.45 (n=11) |
| Individual | Low Experience | 42.73/14.55 (n=11) | 31.67/13.92 (n=9) |
| | High Experience | 63.89/14.09 (n=9) | 63.50/11.56 (n=10) |

Table 2

USE OF SPREADSHEET COMMANDS
Means and Standard Deviations

| <u>SETTING</u> | | <u>INTERACTION</u> | |
|----------------|-----------------|----------------------|----------------------|
| | | Yes | No |
| Paired | Low Experience | 17.00/6.75 (n=10) | 18.57/6.91 (n=14) |
| | High Experience | 29.44/4.52 (n=10) | 23.64/9.51 (n=11) |
| Individual | Low Experience | 16.36/4.52 (n=11) | 19.44/5.83 (n=9) |
| | High Experience | 21.11/6.51 (n=9) | 24.50/6.85 (n=10) |

Table 3

SPREADSHEET PERFORMANCE
Analysis of Variance

| Source | SS | DF | MS | F-Ratio | P-Value |
|-------------------------|----------|----|----------|---------|---------|
| Dyad | 1389.61 | 1 | 1389.61 | 6.624 | 0.012 |
| Interaction | 507.59 | 1 | 507.59 | 2.420 | 0.124 |
| Experience | 17087.60 | 1 | 17087.60 | 81.454 | 0.000 |
| Dyad x Inter | 35.97 | 1 | 35.97 | 0.171 | 0.680 |
| Dyad x Exper | 61.40 | 1 | 61.40 | 0.293 | 0.590 |
| Intr x Exper | 39.97 | 1 | 39.97 | 0.191 | 0.664 |
| Dyad x Inter x Exper | 236.91 | 1 | 236.91 | 1.129 | 0.291 |
| Error | 15943.44 | 76 | 209.78 | | |

Table 4

USE OF SPREADSHEET COMMANDS
Analysis of Variance

| Source | SS | DF | MS | F-Ratio | P-Value |
|-------------------------|---------|----|--------|---------|---------|
| Dyad | 34.57 | 1 | 34.57 | 0.745 | 0.391 |
| Interaction | 23.72 | 1 | 23.72 | 0.511 | 0.477 |
| Experience | 822.61 | 1 | 822.61 | 17.728 | 0.000 |
| Dyad x Inter | 152.45 | 1 | 152.45 | 3.285 | 0.074 |
| Dyad x Exper | 79.93 | 1 | 79.93 | 1.723 | 0.193 |
| Intr x Exper | 67.56 | 1 | 67.56 | 1.456 | 0.231 |
| Dyad x Inter x Exper | 40.90 | 1 | 40.90 | 0.881 | 0.351 |
| Error | 3526.63 | 76 | 46.40 | | |

Spreadsheet Performance

Ss who worked in pairs performed better than Ss who worked individually. Ss who interacted with the instructor outperformed Ss who did not interact with the instructor. However, Table 1 shows that the No Interaction/Low Experience Ss had the lowest average score of all groups. This group pulled down the overall average score of the No Interaction Ss. In two of the four comparisons the No Interaction Ss performed as well as the Interaction Ss. As expected, High Experience Ss performed better than Low Experience Ss.

Use of Spreadsheet Commands

High Experience Ss used more commands than did Low Experience Ss. There was also a significant ($p < .074$) interaction between the learning setting and Instructor Interaction. The means shown in Table 2 suggest that this was due to the No Interaction Ss. No Interactions Ss in the Individual setting used more commands than did their interaction/individual counterparts. In the Paired setting, however, Interaction Ss on average used more commands.

IV. DISCUSSION

Stephenson (1991) had found that instructor interaction had a positive effect on achievement in CBT. In that study all Ss worked individually. In the present study instructor interaction had little or no effect when Ss worked in pairs. Perhaps the social functions usually performed by an instructor are performed by the CBT team partner. Instructor interaction did not have an excessively larger effect on those paired Ss without prior experience, a result reported by Stephenson (1991). In this study low experience Ss working in pairs without instructor interaction performed as well as low experience Ss working in pairs with instructor interaction. This suggests that the team partner can provide the feedback, support, and social functions usually provided by the instructor in a traditional classroom.

Ss who worked individually and received instructor interaction performed slightly (but not significantly) lower than Ss who worked in pairs. The instructor may provide a social dimension to learning which a partner can provide in the paired setting. The lowest scoring Ss were those who worked CBT individually without instructor interaction. This result was also reported by Stephenson (1991). A lack of social interaction impacts weak students more than strong students. Conversely, weak students benefit more from social interaction than strong students.

The Use of Spreadsheet Commands interaction between setting and instructor interaction is hard to explain. Stephenson (1991) reported that Use of Commands did not vary between Ss receiving or not receiving instructor interaction. All Ss learned the commands equally well but some used the commands better. To a large degree, this was also true in the present study. The only notable result may be that High Experience Ss used more spreadsheet commands than Low Experience Ss.

Overall, these results emphasize the social nature of learning. For some students learning is simply a social event. In the traditional classroom the instructor may provide most of the social functions. The computer is unable to provide these functions. So when Ss do CBT individually, interaction with a human instructor has a notable effect. However, when social functions can be provided by a team partner the need to interact with the instructor is reduced.

These results question a frequent justification for CBT, the potential for 1:1 interaction. It may be that a 1 student:1 computer setting is not comparable to a 1 student:1 instructor setting. Due to the social interaction, a 2 students:1 computer situation may be closer to the traditional ideal of 1 student:1 human instructor.

The short-term nature of the tutorial used here limits generalization of the results. The results do suggest that the best CBT environment may not be the one in which students work individually. Higher achievement is found when students work CBT in pairs. The social functions of learning are served well by the study team partner and, in fact, may be served better than by an instructor. CBT instructors should consider arranging CBT in a team configuration.

These results have several other implications. First, if CBT is to be worked in pairs, the software should be designed for pairs. Second, the instructor should be trained to work in a team setting. Third, the entire approach to CBT should emphasize social facilitation. This last suggestion is significant since the usual reason for adopting CBT is the supposed opportunity for 1:1 learning.

Overall, it does appear that the social aspect of learning needs to be considered in CBT. If students are working CBT individually, then the instructor (or course administrator) must provide the social functions. If students are working in pairs, then the instructor's social role is reduced. In this second case the instructor's role may become very specialized. For example, the role could be to provide social support for just the weaker students. The role of the CBT instructor should be considered in the CBT process, and further research on that role should be conducted.

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